# A Mathematicall Manuel:

*Wherein*

Is handled Arithmeticke, planimetry, ſtereometry, and the embatelling of armies.

*Whereby*

Any man that can but add and ſubſtract, may learne to multiply and divide in two houres by *Rabdologie*, *without any trouble at all to the memorie.*

Whereunto

*Is annexed the meaſuring of Superficies, Solids, the gageing of Caske, with inuention of proportionall numbers, fitted to the ſubdiuiſions of gageing Rods; and the embatelling of armies according to the diſcipline now in vſe.*

Written by *Iohn Danſie* ſtudent in the Mathematiques.

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## Lectori Rabdologiæ.

*ARdua qui numeras, quadratis vtere virgis;*
*Multipla cum quotumis queis opus inde leges.*
*Multiplica, atque seca, radices extrahe fidens:*
*Certa, cita, et facilis, dixeris, ista via est.*

Patricius Sandęus.

## Ad Lectorem.

*MVltiplicare iuuat, numeros vel scindere, Lector?*
*Vt factus subitò prodeat atque Quotus:*
*Siue Geometricas vis mensurare figuras?*
*Hîc disces celerem, perfacilemque viam.* Andreus Iunius.

*Qua terrêre solent ab amore Metheseos; illa*
*Hoc paruo inuenies esse remota libro.*

To

# To the right worſhipfull, Sr. *Paul Pinder*, Sr. *Iohn Wolſtenholme* Knights: *Charles Cokaine*, and *Abraham Iacob* Eſquires. Farmors of his Maties generall Cuſtomes.

Righte worſhipfull,

THis Orphane comming vnto me attired in a foraigne habit, & ſpeaking a language thogh ancient, yet in theſe parts not vulgarly vnderſtood; diſcovering not onely by thoſe exterior appearances, but by other remonſtrances of ſingular Art, to containe in him ſomething more then ordinary: I (as a well-willer to the ſcience principally by him profeſſed) gaue him friendly entre-

enterteinment. And finding that by his means great benefit might accrew vnto all ſtudious of that ſcience, haue ſeriouſly laboured in ſuch ſort to inſtruct him to ſpeake our naturall *Idiome*, that thoſe whoſe palates haue not taſted the delightfull variety of his language might neither be fruſtrated of their vertuous deſire, nor deprived of ſo generall a good: hauing with as much art and induſtry as I could inueſted and decked him with ſuch commodious and neceſſary applications, as may moſt aduantage their accept.

But being now to appeare in publique, and to plung himſelf into the conuerſation of not onely various but contrary natures and diſpoſitions, as a ſtranger deſtitute both of meanes either to winne fauour, or repulſe iniuries, I haue made bould to preſent him vnto

your

your worshipps, as particular patrons of that science he professeth, humbly craving that you will vouchsafe to entitle him yours, that through your countenance & patronage, hee may find a more gratefull acceptance and welcome; as also be protected against the calumnies of censorious *Critiks*: And as hereby you shall immortalize your names amongst the patrons of the vertuous, & engage the studious of our nation to admire your care in the preseruation of so generall a benefit: So shall you animate me to attempt matters of a deeper straine; and most strictly oblige me.

Your worshipps,

*In all duty to command.*

IOHN DANSIE.

## To the Reader.

I Haue presented vnto thy view the vse of a dead mans bones: which being first inuented & published in Latine by that ingenious Mathematician the ho. L. Iohn Nepere Baron of Merchiston, is now trawslated into our language; hoping that this home-spunne habit shall not any wayes darken the luster of their deseruing merit.

Whereunto I haue also added the mensuration of Superficies, Solids concaues, regular gageing of Caske very necessary for all such merchants as deale either for wines, oyles, or any other liquids; with exquisite discriptions of instrumenes to gage the said Caske: And new

inuented

inuented numbers accommodated to their seuerall subdiuisions from 8 parts to 20 parts in an inch. Also the embattelling of Armies, necessary to be vnderstood of all such as vindicate that name of a Souldiour, intending hereafter to bee more ample in that discipline, or in some Nauticall contemplation. And lastly the application of all these vnto the admirable tables of Logarithmes, whereby their abundant vse in matters of consequence plainely emergeth, and that euen vnto the vnlearned, whose Arithmeticall breeding doth not exceede addition and substraction.

And herein haue I laboured with all sedulity and diligence to conde all these subiects into this little Enchiridion, or Mathematicall

## To the Reader.

*A B C; wherein I presume (if thou wilt take any paines at all) thou mayest so dainly learne to spell a lesson worth thy paines: for whatsoeuer is promised in the title is really performed in the discourse: wherein if thou findest any faults, let me intreat thee first to amend thine owne: And if thou findest none, then let me intreat thee also to make none.*

**Farewell.**

MVSEVM
BRITAN
NICVM

what

## *What is Rabdologie?*

*Rabdologia, eſt ars computandi per virgulas numeratrices. Rabdologie* (ſaith the Author) is the art of counting, by numbring rodds, ſticks, or as they are vulgarly called *Napeirs bones?*

## *Of what are theſe bones fabricated or made, and of what forme are they?*

THe matter theſe bones are made of is box, ebonie, braſſe, ſiluer, &c. The forme of them is preciſely ſquare; the length about 3. inches: and the breadth about the tenth part of the length. So that when 10. of theſe bones are tabulated or laid downe cloſe one to another, their forme may reſemble an exact ſquare: and if to theſe

10 you adde 10 more, and tabulate those 20, then will their forme represent a paralellogram or oblong square, whose breadth shalbe double to their length: And if to these 20 you adde 10 more, and tabulate those 30, then shall their breadth be triple to their length, &c.

*For what vse serue these Roddes?*

THe vse of them is Arithmeticall aymeing cheifly at the most difficult parts of that art: viz. multiplication, diuision, extraction of the square & cubique Roots whose intricate operations, these little moueables doth so facillitate, that the meaneſt capacity may in 2 houres learne to multiply and diuide, which are the parts indeauored in this little manuell.

*How are these bones figured particularly and generally?*

First

FIrſt in the ſummitie or higheſt part betweene the 2 firſt parallells, of euery particular bone there is one ſimple figure or Cipher; ſo that euery *bone* conteineth 4 ſides, and conſequently 4 figures in the higheſt Collumes or diuiſions. In generall; 10 ſtickes hath 40 ſides and 40 figures in the higheſt diuiſions: fower of them are 0000, fower vnites, or 1111, fower 2222. fower 3333 &c. And whatſoeuer the initiall figure is in the ſummity or higheſt collume at the topp: the figure or figures in the ſecond collume deſcending, is double to the firſt: And the figure or figures in the third collume deſcending is triple to the figure in the firſt: And the figure or figures in the fourth collume is quadruple to the figure in the firſt: And ſo increaſing and deſcending in an Arithmeticall progreſſion til you come to the laſt

number in the bottome; which is noncuple to the first that is as 9 to 1.

## Probleme 1.

*How these bones are to bee tabulated or laid downe when you do either multiply or divide by them.*

Svppose you haue a summe giuen you to be multiplyed: As for example, let the yeare of our Lord 1627 be giuen to bee multiplyed: Because this summe consisteth of 4 figures; therefore you are to chuse 4 *bones*, that haue in the highest collume these 4 figures giuen: then tabulate or lay downe these 4 rodds or bones close together, so that if you begin at the left hand, and count to the right hand, in the vppermost collume of these 4 bones, you may reade the summe propounded, viz. 1627:

And

And thus may you tabulate any ſumme; which being ſo, it is then prepared to be multiplied.

## Prob. 2.

*How theſe rodds do appeare when they are tabulated: and how the product, or multiplex, of euery Collume is to be read.*

THe rodds being tabulated as before: The ſurface or ſuperficies of them towards thine Eye will reſemble the forme or figure of a glaſſe window; For the paralell lines, and the diagonall lines interſecting one another, doth diuide the ſuperficies into *Rhomboydes* like the panes in ſome glaſſe-windowes. Now you are to reade the multiplex of euery collume from your right hand to your left hand, according as the figures are placed

placed in euery *Rhomboydes* or diamond, remembring alwaies to add both the figures together in euery *Rhomboydes* or diamond: And if they doe exceed 10, you are to write the ouerplus of 10 and carry 1, to the next *Rhomboydes* towards your left hand. Note that the first towards your right hand, and the last towards your left hand are but halfe *Rhomboydes* or diamonds: but all the rest are whole ones, as appeareth by the diagram at the latter end of the booke.

PROB. 3.

*How to multiply any ſumme propounded, by theſe bones.*

FIrſt conſider that in multiplication there bee 3 tearmes, viz. multiplicand, multiplier, and product. As if 1627 be giuen to bee multiplied by 365; here 1627 is the multiplicand,

multiplicand, and 365 is the multiplier, and the number increased by their multiplication is called their product. Let 1627 the multiplicand then be tabulated by the 1 Prob: And let 365 be written with a line vnder-drawne as in the margent: then because 5. is the first figure that you are to multiply 1627 by; therefore looke vpon the fifth Colllume, and by the 2. Prob: beginning at the right hand, proceed to the left, (obseruing the *Rhomboydes* or panes) and you shall find the product of 5 to be 8135, that is 5 times 1627, which being set downe, you are then to multi by 6: therefore looke into the sixth Collume and there shall you reade the product of 6, which is 9762, which set downe orderly as in the example. Lastly you are

365
8135
9762
4881
593855

to

to mult by 3: therefore looke vpon the third Collume, and there ſhall you reade 4881, which ſet downe alſo: And then adde thoſe 3 particular productes together, which will be 593855, the product demanded: And thus may you multiply any ſumme propounded.

## Prob. 4.

### *How to diuide any ſũme propounded by theſe bones.*

FIrſt conſider that in diuiſion alſo there be 3 termes, viz. *Dividend, diviſor,* and *quotiens*: As if 593855 be giuen to be diuided by 365. Here 593855 is called the *dividend*, 365 is called the *diviſor*, and that number which ſheweth you how often the diuiſor is conteined in the diuidend is called the *quotiens*. Let 365 then the diuiſor be tabulated by the firſt Prob: which

which being done, let both diuidend and diuisor be set downe on paper as in the margent: then looke vpon the bones, & see what number you can find amongst the Collumes neerest to 593 the three first figures of your diuidend: alwayes remembring that you take not a number from the Collumes greater then the part of your diuidend which you are then in hand with: As here if you reade any of the Collumes of the bones as they are now tabulated, you shall find them all too great, the first onely excepted: 1 therefore is the figure to be put in the quotient: then substract 365 from 593, and the remainder will bee 228. Then are you to review the Collumes of the

2
9
2285
593855(1627
365005
21935
75
2

bones

bones to find a number neereſt to the laſt remainder 228, and one figure more towards the right hand, which will make the ſumme 2288: And if you reade the ſixth Collum, you ſhall find 2190, which is the neareſt leſſe ſume to 2288, & becauſe you find 2190 in the ſixth Collume: 6, therefore is the next figure for your quotient: then ſubſtract 2190 from 2288 reſt 98, then for the third figure for your quotient, looke amongſt the Collumes what number is neereſt to 985: and in the ſecond Collume you ſhall find 730 which is the neereſt: and becauſe you find that number in the ſecond Collume; 2 therefore is the next figure for your quotient, then ſubſtract 730 from 985 Reſt 255. Then looke vpon theſe pretty knackes once againe, and ſee what number you can find neereſt to 2555: And if you caſt your cy:

eye vpon the ſeuenth Collume you ſhall finde the very number it ſelfe 2555: And becauſe you found it in the ſeuenth Collume, 7 therfore is the fourth and laſt figure for your quotient: then firſt ſubſcribe 2555, and then ſubſtract it from your diuidend as before, and nothing remaines.

Thus haue you one example of multiplication and another of diuiſion, which well vnderſtood, I dare bee bold to ſay that you may multiply or diuide any ſumme propounded. For a Gentleman giuing me a ſumme to multply, and ſeeing me doe it, deſired me to proue it by diuiſion, & when I had ſatiſfied him, he importuned me to lend him the inſtruments vntill the morning: I granted his requeſt; in the morning hee ſhowed me 8 ſummes which he had both multiplyed & divided rightly. Yea but *alius alio*

*praſtat*

*præstat ingenio*; and that I cannot denie: but surely that *alio* must be *sine ingenio*, to whom this easie instruction is not sufficient.

### *Admonition.*

NOte if thou hast but 10 rodds that thou canst tabulate but fower figures of one especie or quantity: As fower 1111, fower 2222, fower 3333, fower 4444 &c. but if thou hast 20 rods, then thou maiest tabulate 8 figures of one especie or quantity: And if thou hast 30 rodds, then thou maiest tabulate 12 &c.

### Prob. 5. *Of the rule of three forwards or direct.*

NOw according vnto method (which *Plato* saith is *animæ veræ*) comes the rule of three direct, and inuerse. And here I might

might make a long harueſt, & inſer *montes parturiunt:* But ſurely it would bee altogether vnneceſſary, ſeeing that it conſiſteth of nothing elſe but multiplication and diuiſion. *Example:* Firſt of the rule of three forwards. If 18 doe giue me 36, what ſhall 54 giue me? And becauſe the rule is that you muſt multiply the ſecond by the third, (or the third by the ſecond) and diuide that product by the firſt; Therefore multiply 36 by 54 (or 54 by 36) by the third Prob: and diuide that product by 18, by the fourth Prob: and the quotient will be 108. Which ſignifieth that, if 18 yeeldeth 36, 54 will yeeld 108 according to the reaſon giuen, which was that 18 did yeald 36. And againe becauſe 36 was purchaſed with 18, therefore is 108 purchaſed with 54 by the ſame reaſon. For reaſon is the habitude of

two numbers. *Exempla.* 7 and 8 makes 15, why? By reason of addition. 7 from 15 leaues 8, why? by reason of subſtraction. 7 times 8 is 56, why? By reaſon of multiplication. 56 doth conteine 8, 7 times, why? By reaſon of diuiſion. So that 2 numbers being giuen, a third is found by reaſon of addit: ſubſt: mult: or diuiſion. For the foundation of Arithmeticke is grounded vpon reaſon, and therefore is proportion defined to bee the ſimilitude of reaſon, which doth conſiſt of three numbers at the leaſt, and therefore is called the rule of three.

## Prob. 6. *Of the rule of three inverſe or backwards.*

FOr the rule of three inverſe you are to multiply the firſt by the ſecond, or the ſecond by the firſt; and

and to diuide that product by the third, and the quotient will resolue you. *Example.* If 27 workmen doe build an house in 365 dayes, how many dayes would 12 workmen haue beene about that edifice? First multiply 365 by 27, or 27 by 365, by the third Prob: then diuide that product by 12, according to the 4th Prob, & the quotient will be 821¼ dayes. And so long time would the 12 men haue beene about the same peece of worke, that the 27 men did in 365 dayes. And thus much for *Rabdologie.*

HItherto hath beene showne how to multiply and diuide by *Rabdologie.* Now followeth how to performe multiplication & diuision, by addition and substraction onely, by helpe of the tables of *Logarithmes.* The reason thereof is this,

this, that multiplication doth assimulize with addition: and diuision with substraction reciprocally: for addition and multiplication doe both of them accumulate: and substraction and diuision doe both of them diminish. Therefore to take away the tedious operations of multiplication and diuision, the logarithmes were inuented, whose Symptomes and proprieties are so proportionally affected, that instead of multiplying, they adde: & in stead of diuiding, they substract: which being considered, let vs come to their vse.

### *How to multiply and diuide by the tables of Logarithmes.*

FOr multiplication, obserue this rule. Adde the *logs* of the *multiplicand* and the *multiplyer* together and that summe shalbe the log. of the

the product. *Exempla.* Multiply 43 by 23: that is, adde the log: of 43, to the log. of 23. Againe multiply 17 by 39, that is, adde their logarithms together as followeth.

| | | | | |
|---|---|---|---|---|
| *Multiplicand* | 43 | 163346 | 17 | 123044 |
| *multiplier* | 23 | 136172 | 39 | 159106 |
| *product* | 989 | 299518 | 663 | 182150 |

The first product is 989, the second product is 663.

For diuision obserue this rule. From the log. of the diuidend, substract the log. of the diuisor, and the remainder will be the log. of the quotient. *Exempla.* Diuide 100 by 10, that is, from the log. of 100, substract the log. of 10. Again diuide 966 by 42: that is, from the log. of 966, substract the log. of 42, as followeth.

| | | | | |
|---|---|---|---|---|
| *Dividend* | 100 | 200000 | 966 | 298497 |
| *diuisor* | 10 | 162324 | 42 | 162324 |
| *quotient* | 10 | 100000 | 23 | 130173 |

The first quotient is 10, the second quotient is 23.

*The rule of three direct and inuerse by the Logarithmes.*

BEcause these rules are performed by multiplication and diuision: Therefore adde the logs. of the second and third numbers together, and from that summe take the log. of the first, and the remainder shall be the log. of the number sought. *Exempla.* If 18 giue 36, what shall 54 giue? Mr. *Briggs* in *lib. Arith. log.* substracts the log. of the first number, from the log. of 10, and the remainder hee calls the Complement of Arithmeticke, which complement he adds to the second and third proportions giuen, and cutts of the first figure towards the right hand, and the other figures are the log. of the 4th. number sought: As if 6 giue 15, what shall 26 giue? 18

| | | | |
|---|---|---|---|
| 18—125527 | 6—922184 | *Complements.* | |
| 36—155630 | 15—117609 | | |
| 54—173239 | 26—141497 | | |
| 328869 | 65-1 | 181290 | |
| 108—203342 | | | |

Thus haue you found that the answer of the first question is 108: & the answer of the second is 65.

For the rule of three backwards: Adde the log. of the first and second together; & from that summe substract the log. of the third, and that remainder shall be the log. of the number sought. *Exemp.* If 12 masons make a certaine wall in 20 dayes, how many shall make the like in 5 dayes. Againe if in 16. hours 100 pioners be able to make a certaine trench: how many pioners will be required to make the like trench in 4 houres?

| | |
|---|---|
| 12—107918 | 16—120411 |
| 26—130102 | 100—200000 |
| 238020 | 320411 |
| 5—069897 | 4—060205 |
| 48—168123 | 400—260206 |

The first quotient that answereth the first question is 48: the second quotient which answereth the second question is 400: which showeth that 400 pioners can doe as much in 4 houres, as 100 can doe in 16 houres.

Thus haue you multiplication, diuision, and the rule of three shown you. And although I giue but few examples, yet are they so generall, that there is hardly any question demanded in vulgar Arithmeticke, but it may bee answered by multiplication and diuision; which two parts performeth the rule of three. All which you haue here done, first by *Rabdologie*, and secondly by

the logs: the pleasant variety wherof I refer to your practise. And so I proceede to the measuring of so many *Geometricall* figures, as is necessary for most men to vnderstand.

It is a rule in *Geometry*, that *two straight lines cannot enclose*, or *make a plot*: But 3 lines, 4 lines, 5 lines, may enclose and determine a superficies, or plot.

*What is a line?*

2 Def. *Linea est longitudo expers latitudinis.*

A line is longitude without latitude, that is length without breadth. And it is the common tearme of a *Superficies*.

*What is a Superficies.*

2 Def. *Superficies longitudinem et latitudinem habet sine profunditate.*

A *Superficies* hath length and breadth, but no profunditie or deapth: And is the common tearm of a *bodie*.

*What is a body.*

3 Def. *Corpus longitudinem, latitudinem et profunditatem habet.*

A *body* hath length, breadth and depth; And is the common tearme of a *place*.

So that it seemes lines do determine and bound a superficies; and superficies doe determine a body: and bodies do terminate & bound a place. *Exempla.* A square superficies is bounded and determinated by 4 lines consisting of equall length. A *Globique superficies*, of one circular line, being in all places equidistant from his Center.

A *Cubique solid* (in figure like a dye) is bounded and determinated

ted by the planes of 6 ſuperficies. And the conuex ſolid of the ouen doth terminate the concaue place thereof. And the ſolid walls, floore and ſealing, doth terminate and bound, the conceined place of the roome.

The meaſure then of a *ſuperficies* conſiſteth but of two lines, by the ſecond definition, viz. *length* and *breadth*. But the meaſure of a ſolid body conſiſteth of three lines, by the third definition, viz. *length*, *breadth* and *deapth*: which threefold dimenſion is alſo proper to a *place*.

If you would then meaſure the ſuperficies of any thing that is ſquare, multiply one ſide by it ſelfe (which is called the ſquaring of a ſide) or one ſide by another (which is all one) And that product ſhall be the content ſought.

*Example.* Suppoſe *A B C D*, a perfect ſquare, and you deſire to

know how many ſquare inches of any thing will couer the ſame. Take a ruler which is diuided into inches, and meaſure with that ruler any one of the ſides, which ſuppoſe you find to be 30 inches, now becauſe euery ſide is alike, therefore you muſt multiply 30 by 30, according as you are taught in the third prob: and the product will be 900. And ſo many ſquare inches will ſerue to couer the *ſquare A B C D*, whoſe ſide is found by meaſure to be 30 inches: And thus may you meaſure the ſuperficies of any ſquare whoſe ſides are equall.

If the ſides be vnequall as in the figure *E F G H*, then are you to multiply the two vnequall ſides together, and that product ſhall bee the ſuperficiall content.

*Example.* Suppoſe you finde by meaſure as before, that *E F* the breadth

breadth is 20 inches, and *F G* the length is found by measure to bee 80 inches: multiply 80 by 20, that is the length by the breadth, and the product will bee 1600 inches: therefore so many square inches will couer that long square, or *parallelogram* (as it is called,) whose length and breadth is alwayes vnequall.

Now if you would know how many foote square of stone would serue you to paue any roome: First measure the length and breadth of the roome in inches, and multiply one summe by another, and that product shall be the content in inches: Then because you would know how many square foote would serue, therefore you are to reduce those inches into feete by diuiding them by 144, because so many inches do mak a foot square.

*Example.* Suppose if the breadth of

of the roome be found by meaſure 88 inches, and *F G* the length of the roome 144 inches, theſe two multiplied according to the third Prob. produceth 12672, which if you diuide according to the fourth Prob. your quotient will be 88, and ſo many ſquare foot will ſerue thy turne.

If you would hang your roome with darnix, or any other ſtuffe, & deſire to know how many ſquare yards will ſerue the turne: firſt take the length and breadth in inches as before, and mult. them together, that product will ſhow you how many ſquare inches wil ſerue: Then if you diuide that product by 1296, for ſo many inches are in a yard ſquare; that quotient ſhall ſhow you how many yards will ſerue.

*Example.* Suppoſe *EF* the height of the roome 98 inches: *F G* the length

length of the roome 1296 inches: these mult. by the third probleme, produceth 127008: and this summe diuided by 1296, according to the fourth Prob. quoteth 98. And so many yards square will serue thy turne.

If thou hast a window to glaze, & would know how many foote you are to pay for, or how many to demand money for when thou hast done it, first take the height of the window in inches, then the length in inches, and multiplie these together; then diuide that product by 144: and that quotient will resolue you.

*Example.* Suppose *E F* the height of the window 30 inches, *F G* the length 144 inches: these multiplied together produceth 4320 inches, which being diuided by 144 according to the fourth prob. quoteth 30. And so many foot art thou to pay for.

*Now*

*Now followeth the measure of all triangles.*

IF thou wouldest haue the superficiall content of any *triangle* whatsoeuer, multiply the base by halfe the perpendicular facit the content: or mult. the perpendicular by halfe the base facit the content: Or mult. the perpendicular by halfe the base, & that sume shall bee the content. The reason thereof proceeds from these *Theoremes.*

*The superficiall content of any triangle whatsoeuer is equall to that paralellogram, or long square, which is made of the base and halfe the perpendicular; or of the whole perpendicular, and halfe the base: Or to halfe that paralellogram, which is made of the whole perpendicular & the whole base.*

So that if any triangle be giuen,

and

and the ſuperficiall content required, worke by any of theſe rules, and you ſhall haue the content deſired. *Exempla.* Let the *area* or ſuperficiall content of the *Triangle I K M* be ſought.

Here *I M* is called the baſe of the *triangle*: *K L* is called the perpendicular: and *N L* is halfe the perpendicular. Let *I M* be meaſured 300 inches, and let *L K* be meaſured 250 inches. Now halfe *L K* 250 is 125, for *L N*, halfe the perpendicular; which multiplied by 300, *I M* the baſe produceth 37500 ſquare inches for the ſuperficiall content, of that triangle *I K M*, whoſe baſe was meaſured 300, and perpendicular 250: Or mult. *L K* the whole perpendicular, by *I L* halfe the baſe, viz. 250 by 150 by the third Prob. facit 37500 as before: Or multiply *K L* the whole perpendicular by *I M* the whole baſe,

base, viz. 300 by 250 facit 75000 inches, halfe whereof is 37500 inches as before.

Thus haue you three wayes to find the superficiall content of any triangle whatsoeuer. Now it followeth how to measure all regular *Poligons.*

*Theoremes.*

*Euery regular Poligon is equall to that Paralellogram, or long square, whose length & breadth is equall to the perpendicular, & halfe the perimitrie.*

Therefore multiply the perpendicular by halfe the *perimitry*, and that product shall be the superficiall content. *Exempla.* Let the *Pentagon O* be giuen, and the superficiall content thereof demanded.

First find the center thereof as at *O*, then from *O* let a line be drawn to the midst of any one of the sides as *O P*: that *O P* is called the perpendicular,

pendicular, and is one of the lines of meaſure. Then let one of the ſides be meaſured, and whatſoeuer that is, the whole *perimitrie* of the *pentagon* is 5 times ſo much, the halfe whereof is the *ſemiperimitrie*: and that is the ſecond line of meaſure.

Suppoſe then one ſide of the *pentagon* to be 28 inches by meaſure, then is the fiue ſides 140 for the whole perimitrie, the halfe whereof is 70 for the ſemiperimitrie: which multiplied by the perpendicular *OP*, (which ſuppoſe you find it) 22 inches, produceth 1540 inches for the ſuperficiall content ſought.

And if the ſide of the *hexagon Q* be giuen 24, and the perpendicular *QR* 21: and the ſuperficiall content thereof demanded: The whole perimitrie of that hexagon wilbe 6 times 24, that is 144: halfe whereof

whereof is 72 the ſemiperimitrie: which multiplied by 21 the perpendicular produceth 1512 for the content of that hexagon. In like manner may you find out the content of any regular *Poligon*, how many ſides ſoeuer it haue.

By this time I hope you perceiue that the dimenſion of any regular ſuperficies conſiſteth of theſe two lines, viz. *length* and *breadth*, the meaſure whereof being giuen either in inches, feete, yards &c. the content is had by their multiplication onely; which is briefly and perſpicuouſly ſhowne in the third Prob: and that by *Rabdologie*. I will now ſhow you how to meaſure theſe ſuperficies by addition and ſubſtraction onely, and that by helpe of the tables of the logarithmes. And herein if the ſummes I vſe be not ſo large as you expect, by reaſon here is inſerted but the

first Chiliad of logs. yet by them you shall vnderstand how to work any summe how big soeuer it bee. And although I cannot exceede 1000 inches, foote, yards, &c. by reason these tables extend no further, yet if you do apply these examples (or the like) in greater numbers: to that volume of logs. calculated and published by Mr. *Briggs* in a booke whose title is *Arithmetica Logarithmetica*, I make no question but they shall be both profitable and delightsome to thy practice.

*The side of a square being giuen in inches, to find the superficiall content in inches.*

ADde the log. of the side giuen to the log. of the side giuen; that is, set downe the log. of the side giuen twice, and adde them together:

together: or double the log. of the side giuen: and that summe shalbe the log. of the superficiall content required. *Exempla.*

1 Let *AB* the side of a square be giuen 28 inches, what is the content of *A B C D*?

2 Let *AB* be 19 inches, what is the content of *ABCD*?

| | |
|---|---|
| 28—144715 | 19—127875 |
| 28—144715 | 2 |
| 784—289430 | 361 255750 |

The answer of the first question is 784 inches: The answere of the second question is 361 inches.

*The length of a foote being giuen in inches: to find the content of a foote square in inches.*

*The length of a yard being giuen in inches: to find the content of square inches in a yard square.*

Let

LEt *A B* the length of a foote bee 12 inches; or *A B* the length of a yard bee 36 inches, (which is three foot) and let their contents be sought. *Examples.*

| | |
|---|---|
| 12—107918 | 36—155630 |
| 12—107918 | 36—155630 |
| 144—205836 | 1296—311260 |

The foot square hath 144 square inches: And the yard square hath 1296 square inches; which logarithme although it be greater then is conteined in this Chilliade of logs. Yet notwithstanding do not neglect it, for it serueth to reduce square inches into square yards, as shall appeare. But if the length be greater then the breadth; or the bredth be greater then the length, then are they to bee applied to the oblong square or paralellogram as followeth.

The

*The two vnequall sides of a paralellogram, being giuen in inches: to find the content in inches.*

LEt *E F* be found by measure, to be 20 inches for the *bredth*, and *F G* be found by measure to be 30 inches for the *length*: Or let *E F* be 19 inches, and *F G* 29 inches.

Here you haue no more to doe but to adde the logs. of their *length* and *breadth* together: and that summe shall be the log. of the content required. *Example.*

| | |
|---|---|
| 20—130103 | 19—127875 |
| 30—147712 | 29—146240 |
| 600—277815 | 551—274115 |

The content of the first propo. is 600 square inches. The content of the second prop. is 551 square inches. The like is to bee obserued in all questions whatsoeuer, whose

whose length and breadth is vnequall.

If a yard of stuffe be 36 inches in length, and 72 inches in breadth, I demand:

*First how many inches doth that yard conteine? Secondly how many foote doth that yard conteine?*

FOr the first question adde the logs. of 36 and 72 together, & that summe shall be the log. of the square inches demanded. Then from that log. substract the log. of 144 (because there be so many inches in a foote) and that remainder shalbe the log. of the feete, demanded in the second question.

*Example.* Let *E F* bee 36 the length: and *F G* 72 for the breadth.

36—155630
72—185733
2592—341363
144—215836
28—125527

The inches answering to the first question is 2592, from the log. whereof if the log. of 144 be substracted, the remainder is the log. of the foote, which answereth the second question; and is found to bee 18: for so many foote doth that yard of stuffe conteine.

Now if you would paue any roome whatsoeuer, and desire to know how many square foote will serue your turne. Or if you haue any window to glaze, and desire to know how many foote will serue: take the length and breadth in inches, and adde their logs. together, then from that summe substract the log. of 144. And that remainder shall be the log. of the feet demanded.

*Exempla.* Let *E F*, be found by measure

measure to be 144 inches for the breadth of the roome, and *FG* 489 inches for the length.

Or suppose *EF* 79 inches for the height of a window, and *FG* 576 inches for the length of the window, and let the square feete for either purpose be demanded.

| | | | |
|---|---|---|---|
| 144 | 215836 | 79 | 189763 |
| 489 | 268931 | 576 | 276042 |
| | 484767 | | 465805 |
| 144 | 215836 | 144 | 215836 |
| 489 | 268931 | 316 | 249969 |

You are to haue 489 square foot of stone to paue your roome according to the first question.

And you are to haue 316 square foot of glasse to glaze your window, according to your second question.

If you haue a room to hang with any kind of stuff that is yard broad, and

and desire to know how many yards will serue the turne. Or if you would hang it with stuffe of yards broad, and desire to know how many square yards will serue

First adde the logs. of the length & breadth of the roome together measured by inch measure as before: then from that summe, take the log. of 1296, which is found in the last worke of the square: And that remainder shall be the log. of yards, which will serue turne when the stuffe is yard broad. And if the stuffe should be 2 yards broad, you may worke as if it were but one yard broad, for the halfe of that shall be your desire.

*Example.* Admit *EF* the height of the roome to be 100 inches: *FG* the length of the roome round about to bee 324 inches. Or admit *EF* the height of the roome to be 100 inches, and *FG* the length

be

bee 324 according to the second queſtion alſo: here in theſe two queſtions you may vſe one work, but the latter queſtion; becauſe the ſtuffe is double in breadth, therefore halfe ſo much will hang that roome, as appeareth.

100—200000
324—251054
451054
296—311260
25—139794

Here you ſee that the little roome or cloſet whoſe height is 100 inches, and compaſſe round is 24 inches; will require 25 yards of ſtuffe, if it bee but yard broad: but if the ſtuffe be two yards broad then halfe 25, that is 12 and a halfe will ſerue turne.

And if the ſtuffe had beene but halfe yard broad, then might you alſo haue wrought as you did, for the double thereof would haue ſerued the turne. ſo would that roome haue taken vp 50 yards, if it had

beene but halfe yard broad, &c.

But if you take the *breadth* of your ſtuffe in inches, and to that number of inches, adde the log. of 36 which is the *length* of a yard: that ſumme ſhall be the log. of that number, which ſhall ſhow you how many inches is in one yard of that ſtuffe, of what breadth ſoeuer it be. *Example.*

Suppoſe the ſtuffe to be 29 inches broad: or 49 inches broad, and you deſire to find the log of thoſe inches which are conteined in a yard of that ſtuffe.

| | | | |
|---|---|---|---|
| 29 | 146239 | 49 | 169019 |
| 36 | 155630 | 36 | 155630 |
| | 301869 | | 324649 |

Here you haue found the logs: but they are too great for the firſt Chiliade in this booke: But in the ſecond Chiliade, you ſhall find the number

number 1044, answering to the first log. and in the same Chiliade 1764 answering to the second log. which resolueth the first and second question. Or if you multiply the length and breadth giuen by the third Proble: that product will show you what number it is to whom that log. so produced belongeth: So if you multiply 29 by 36, the product will be 1044, &c. And now I proceede to all *triangulate* dimensions.

*The measure of halfe the perpendicular of any triangle whatsoeuer: and the measure of the whole base, being giuen: to find the content of that triangle.*

YOu haue three wayes taught to get the superficiall content of any triangle by *Rabdologie:* I wil only apply them to the logarithms, and proceed. C 2 Let

Let *N L* be giuen 20 inches for the measure of halfe the perpendicular. And *I M* 40 inches for the measure of the base: And let the content of the triangle *IKM* be sought.

Adde the log. of 20 to the log. of 40 facit the log. of the content sought. *Example.*

| | |
|---|---|
| 20—130102 | Thus haue you found that the superficiall content of this triangle is 800 inches, and if you had no more wayes but this one it were enough. |
| 40—160206 | |
| 800—290308 | |

2 *The whole perpendicular and halfe the base being giuen, to finde the content.*

3 *Also the whole perpendicular, and the whole base being giuen; to finde the content.*

Admit

ADmit *K L* the perpendicular 24 feete; and *L M* the halfe baſe 12 feete: what is the content in feete? Alſo admit *L K* the perpendicular 30 yards. And *I M* the whole baſe 26 yards: what is the content in yards?

1 Adde the log. of 24 to the log. of 12, facit the log. of the content in feete.

2 Adde the log. of 30 to the log. of 26, and that ſumme ſhall be the log. of the double content of the triangle; halfe whereof ſhall be the content ſought. *Exempla.*

| | | | |
|---|---|---|---|
| 24 | 138021 | 30 | 147712 |
| 12 | 107918 | 26 | 141497 |
| 288 | 245939 | 780 | 289209 |

The anſwer of the firſt is 288. But the anſwere of the ſecond is but halfe of that produced number 780, that is 390. And now for

*Poligonique* regular figures.

1 *The perpendicular, and halfe the perimitrie of a Pentagon being giuen, to find the content of that Pentagon.*

2 *The perpendicular, and halfe the perimitry of a hexagon being giuen; to find the content of that hexagon.*

LEt *O P* the *perpendicular* of the *pentagon* bee giuen 7 foote: and 1 side of the *pentagon* 12 foote: then will the 5 sides bee 60 foote, halfe that is 30 for the *semiperimitrie*: the log. whereof being added to the log. of the perpendicular, giues the log. of the content of the *pentagon*.

In like manner let the perpendicular of the *hexagon Q R* be giuen 11 yards, and the side thereof 14 yards, then is the 6 sides 84, the halfe whereof is 42 for the *semiperimitrie*

metrie of the *hexagon*; the logarit. whereof being added to the log. of the perpendicular 11, will giue the content of the *Hexagon*.

*Exempla.*

| | |
|---|---|
| 30—147712 | 11—104139 |
| 7—084509 | 42—162325 |
| 210—232221 | 462—266464 |

The answere of the *pentagon* is 210 foote: the answer of the *hexagon* is 462 yards. In like manner are measured all regular *Poligons* whatsoeuer.

Thus much for *superficies*, and now I come to the measuring of regular Solids, as stone, timber, or regular continents, intending to giue but a touch of them, seeing that a volume is more fit for such a subiect then a Manuell.

## *The measuring of Solids.*

THe dimension of a *solid body* consisteth of three lines, (saith the definition) *length*, *breadth* and *deapth*. To attaine the solid capacitie then, of a regular body, these three lines must bee knowne: of which three, two of them I hope you are very well acquainted withall already. There is then but another line wanting, to conuert your superficiall practise into solid: And that line is called the line of *deapth*, by the definition. That line of deapth then is a perpendicular line so long as the *solid body* is erected vpwards: But if that magnitude or body, doe lie along, then is that line conuerted into the line of *length*, according to *Archimedes*, *Euclid*, *Clauius* on *Sabracosco* &c. who all agree, that so long as any magni-

magnitude is ſaid to bee: ſo long is the perpendicular ſaid to bee: Therfore the *length* of a ſolid body, is the third line meant, in caſe the ſolid you meaſure, lie along vpon the ground. But if it bee erected vpwards, then that perpendicular line, (or plumbe line) is called the line of *deapth*.

If this ſolid body doe conſiſt of an vniforme dimenſion, whoſe *length*, *breadth* and *deapth* is equall; then is it called *Hexaedron*, or *Cubus*; and is encloſed with 6 equall ſquares: whoſe plaines are alſo vniforme; and are ſaid to determine, and bound the ſoliditie of the ſaid *Cube*.

An exact example hereof is demonſtrated in a ſquare regular dye whoſe body, or ſolid content is a true *Cube*.

If then you haue a peece of timber, ſtone &c. whoſe *length*, *breadth*

and *deapth* is of one dimenſion, like a dye, and you deſire his craſſitude or ſolidity, you are to Cube any one of his ſides; that is to ſquare a ſide firſt, and then to increaſe or multiply that ſqnare number, by his deapth: and that product ſhall giue you the Cubicke, or ſolid quantity, of his body. *Example.*

Suppoſe you haue a peece of timber which is a foote ſquare euery way, and you deſire to know how many Cubick inches it conteineth:

Firſt if you meaſure the length, you ſhall find it 12 inches: then is the breadth 12 inches, and the deapth 12 inches: alſo becauſe all the ſides thereof are vniforme; therefore multiply 12 by 12 according to the third Probleme, and the product wilbe 144; which is the ſquare of one of the ſides: & the ſuperficiall content of any one of the plaines, becauſe they are alſo vniforme:

vniforme: then if you multiplie 144 that plaine by 12, the line of deapth, the product will bee 1728 inches: for so many inches arein a foote Cube, or solid. And thus may you get the solid content of any Cubique, or solid body, whose sides and plaines are vniforme.

2 But if the solid bee not vniforme as aforesaid: then measure the superficies at the end thereof, and multiply that product by the length thereof, and that product shall be the solidity thereof.

*Example.* If the end of the peece of timber, stone, or any other solid be oblong, as the figure *EFGH*, doth demonstrate. Then find the superficies at one end, by multiplying the two vnequall sides of the end: which superficies if you multiply by the length of the solid, that product shall be the solid capacity, in Cubique inches: the which

which inches if you diuide by 1728, that quotient will giue you the content in ſolid or Cubique feete.

3 If the ſolid be not equall at the ends, but the ſuperficies at one end, is greater then at the other, then obſerue this rule: Find the ſuperficies at both ends, and adde them together, the halfe whereof ſhalbe the meane ſuperficies: which multiplied by the length ſhal giue the ſolidity in inches, which you may reduce as before.

4 If you haue a ſolid triangulate peece of timber, ſtone, &c. Then find the *area* at the end, and multiplie that ſuperficies by the length, facit the content in ſolid inches: which you may reduce into feete as before.

5 If the triangulate ſolid be greater at one end, then at another, find the area at both ends, the hal-

whereof

whereof if you multiply by the length facit the content in ſolid inches: which you may reduce into feete as before.

6 If you haue a peece of ſolid timber, ſtone &c. in a *poligonick* form at the end (as *O* or *Q*) firſt finde the area at the end in inches, (as is taught already in the doctrine of *poligons*) then multiply that ſuperficiall content, by the length, facit the content in inches: the which you may reduce into feete as before.

7 If you haue a round ſolid, and deſire his content, worke thus. multiply the length of the diameter at the end, by it ſelfe: then multiply that ſquare number by 11; that product diuide by 14, and that quotient mult. by the length, facit the content in inches: which you may reduce into feete as before.

But

But if the ends of the round solid be not so great at one end as at another; then square the diameters at each end, and adde them products together, the halfe whereof if you mult. by 11, diuide by 14, and that quotient mult. by the length of the solid, facit the content in inches: which you may reduce into feete as before. Now to apply these vnto the logs.

*How to measure vniforme solids by the Logarithmes.*

IF you desire to know how many solid inches there are in a foote Cube, set downe the log. of 12 three times, and adde them together; that summe shall bee the log. of 1728: for so many Cubick inches are in a foote solid.

*Example.*

12—107918
12—107918
12—107918
1728—323754

And although this log. be greater then any that is conteined in this Chiliade, yet neglect it not, for it serueth to reduce inches into feete, as may appeare in the examples following.

*How to measure oblong solids.*

IF you would measure a peece of timber, stone, or any other solid whose end is oblong, or like the *paralellogram E F G H*: and you desire his content in feete.

Suppose *E F* 16 inches, *F G* 24 inches: and the length of the solid 200 inches. Adde the logs. of those three numbers together, and you haue the log. of the solid content in inches: from which if you take the log. of a solid foote, you haue the content in in feete.

*Example.* 16

16—120411
24—138021
200—230103

488535
1728—323754
44—164781

Thus you haue found that in the ſolid propounded there is found 44 ſolid feete, and ſomewhat more; and if you deſire to know how much more, do thus.

Take the difference of the logs. of 44 and 45, which will be found to be 976: this is the *denominator* ſought: then ſubſtract the log. of 44, from the log. produced: whoſe difference is 437: this is the *numerator* ſought: the log. produced, then is the log. of 44 & $\frac{437}{976}$, which fraction is almoſt halfe of one foot: the feete demanded then is 44 and almoſt an halfe. Mr. *Briggs* hath a learned way to finde out this proportionall part, in the 11th. Cap. of his book called *Arith. log.* where he transferreth the log. produced to the latter Chilliades: which way

becauſe

because I thought somewhat too prolix for this abbridgment I did omit.

*How to measure triangulate solids.*

LEt *I K M* represent the end of a *triangulate solid*, whose crassitude you desire in feete.

Suppose *N L* 18 inches: *I M* 32 inches: and the length of the solid 762 inches.

Adde the logs. of these three numbers together, and that summe is the log. of the content in solid inches: from which if you take the log. of a solid foote, you haue the log. of the content in feete as before. *Example.*

18—125527
32—150515
762—293550
569592
323754
287—245838

Thus haue you found that in the solid propounded there is 287 foote, and about a third part of a foote found out as before.

*How*

*How to measure Poligonique solids.*

LEt the *Pentagon O*, represent the end of a solid: Or the *Hexagon Q* represent the end of a solid: And let their content in solid feete be demanded.

*Let O P* the *perpendicular* be 22 inches: let the *semiperimiter* be 70 inches: and let the *length* bee 324 inches,

Or let *Q R* the perpendicular be 21 inches: the semiperimitrie 72: and the length of the solid 300 inches. And let the solid content of the pentagonique solid and the hexagonique solid bee sought in feete.

Adde the logs. of the perpendicular, of the semiperimiter, and of the length of the solid together, & that summe shall be the content in inches: from which log: if you take the log. of one foote, that remaining

ning log. ſhall bee the log. of the ſeete demanded. *Exempla:*

| | |
|---|---|
| 22—134242 | 22—132221 |
| 70—184509 | 72—185733 |
| 324—251054 | 300—247712 |
| 569805 | 565666 |
| 323754 | 323754 |
| 289—246051 | 262—241912 |

*How to meaſure circular or round ſolids.*

TO get the groſſe ſolid content of circular, or round ſolids, as trees, collumes of wood, ſtone &c. I haue inuented a common or generall number, whereby you ſhall know their ſolid quantity by one addition onely, and that with fewer numbers; then to follow the rule preceding.

Firſt then ſet downe the log. of the diameter at the end of the ſolid

lid twice. Secondly ſet downe the log. of the length of the ſolid. Thirdly ſet downe this generall number 665772. Then adde thoſe fower logs. togeather, remembring to cut off from that ſumme the firſt figure towards your left hand: for the other figures towards your right hand ſhall be the log. of the content in ſolid feete demanded.

*Exempla.* 1 Suppoſe the diameter at the end of a round ſolid to bee 40 inches, and the length of the ſolid 200 inches: and you deſire to know his ſolid content in feete.

2 Or ſuppoſe the diamiter at the end of a round ſolid to bee 35 inches, and the length thereof to be 367 inches: and you deſire his ſolid content.

For the firſt queſtion ſet downe the log. of 40 twice, then the log. of the length; and then the common number aforeſaid.

In

In the ſecond queſtion or demand alſo ſet downe the log. of 35 twice: then the log. of the length: and then the common number aforeſaid; and by addition you ſhall find the content in feet, as appeareth.

| | |
|---|---|
| 40—160205 | 35—154406 |
| 40—160205 | 35—154406 |
| 200—330102 | 367—256466 |
| 665772 | 665772 |
| 145-1 \| 216284 | 204-1 \| 231050 |

The anſwer of the firſt demand is 145 foote and a halfe. The anſwer of the ſecond demand is 204 feete and about a halfe.

And thus haue I ſhowne you how to find the content of regular ſolids, when the ends are equall: But if the ends be vnequall, then take theſe generall rules.

In ſquare bodies meaſure the breadth and thickneſſe in the midſt thereof

thereof: then worke as is taught.

In round bodies or ſolids take the diameter in the midſt: and then worke as before,

And now I proceede to the gageing of Caske.

*To gage is to finde the content of any veſſell aſſigned, in ceſterns, gallons, potties, quarts, pintes, &c.*

OF veſſells there bee diuerſe ſorts: firſt in reſpect of their quantities, as conſiſting of ſeuerall continents: And ſecondly in reſpect of their qualities, as conſiſting of ſeuerall formes. And therefore to demonſtrate all were without end, and to demonſtrate ſome is to little end; ſeeing that practice is the only miſtriſſe of this ſcience.

My deſire herein is only to handle

dle the gageing of ſuch Caske, as conteineth ſuch matter, that (before this art bee firſt ſhowne) are ſaid, not to bee lawfully vendable. And herein I will indeauour to giue ſuch inſtruction, that the meaneſt may be capable, and the capable confirmed.

You found before that **rotund** or circular ſolid contents, were attained, by the *Diameter* and the *length*: the content of veſſells, are ſo alſo attained: but the matter is difficult to find out ſuch a diamiter to a veſſell, which ſhall carry ſuch a proportion with his length, as that they ſhall afford a true content. My reaſon is that although the diameter at the boudge, and the diameter at the head, haue proportion one to another in reſpect of themſelues: yet in reſpect of the content that is meaſured by them, their proportion is erroni-

ous,

ous. And becauſe the way to find the content or quantity is firſt to finde out certaine lines; and that theſe lines are vncertaine; it remaines then that this vncertainty be ſalued.

Firſt then conſider that moſt veſſells haue but three lines to bee meaſured: but ſome veſſells haue fower lines, according to their ſeuerall formes.

Thoſe veſſells that haue both heads equall, haue but three lines to be meaſured: But thoſe veſſells whoſe heads or ends are vnequall, haue fower lines to be meaſured.

The three lines that are to bee meaſured, in that veſſell whoſe heads are equall, are. 1 the *line of length.* 2 the *diameter* at the head: & 3 the *diameter* at the *bondge.* Betweene which 2 diameters there is ſuch a *meane diameter* to be found that it may mentally reduce the veſſell

veſſell into a regular *Cylinder*; and yet the *veſſell* ſtill retaining his former length notwithſtauding. And this diameter is called the *meane diameter* or *line of meaſure*.

The fower lines that ſome *veſſells* require when the ends or heades are vnequall are. 1. the *length* of the veſſell. 2. the *diameter* at one end. 3. the *diameter* at the other end. 4. the *diameter* at the *boudge*: betweene which 3 diameters there is ſuch a meane diameter to bee found, that it may mentally reduce the veſſell aſſigned into a regular *Cylinder*; and yet the veſſell ſtill retaining his former *length* as before. And this diameter is called the *meane diameter* alſo, or the *line of meaſure*.

Now omitting the curious definitions of theſe *lines*, and alſo that irregular *elliptical line*, which paſſeth from the interiour part of the

head to the center of the *boudge*, concurring with the conuexitie of halfe the length of the *veſſell*: And committing them to the nice conceited Mathematician, I returne to my induſtrious gager.

### *The parts of gageing.*

GAgeing conſiſteth of 2 parts; *meechanicall*, and *artificiall*: that is, *Inſtrumentall* and *Arithmetical*. The lines prenominated are attained by inſtrument: But the *meane diameter*, or *line of meaſure* is attained by Arithmeticke: by which line and the line of *length*, is alſo had the content of the veſſell deſired, as followeth.

### *How the inſtrument is to bee graduated.*

FIrſt let the inſtrument called a gageing rod be diuided into equall

quall inches; and euery inch ſubdiuided into what parts you pleaſe: my counſell is; that euery inch may be ſubdiuided into 10 parts, for then if you put the rodd into the boudg to the bottome of the veſſell, and find it 30 inches deepe, you need bnt adde a cipher to that number, and t will be 300, and ſo are your inches reduced into parts: If the *diameter* had beene 30 inches, and 6 parts of an inch, then inſtead of the cypher adde 6, and it will be 306 parts &c.

Thus are your inches eaſily reduced into parts, and your inſtrument freed from the multiplicitie of figures.

*The line of length.*

FIrſt for the thickneſſe of the heads of the Caske at the ends: you are to allow parts according to the condition of the Caske, and

that I referre to your owne practicall iudgement; refuſing to admoniſh you, ſeeing that their thickneſſe is of ſuch diuerſitie. Only theſe parts are to be abated from the length of the Caske, extending in a ſtraight line from one head to another; and the remainder is the *line of length*: which ſuppoſe to be 50 inches 6 parts, that is 506 parts: And this is your *line of length*.

### *The diameter at the boudge.*

TAke your inſtrument being graduated vpwards, and put it downewards into the boudge to the bottome of the Caske: the parts cut by the lower edge of the bung hole, ſheweth the parts conteined in that diameter, which ſuppoſe to be 30 inches 6 parts, that is 306 parts: this is your *diameter at the boudge*.

*The diameter at the head.*

TAke the diameter at the head with any instrument that may extend at pleasure, or draw forth as a knife out of a sheath; and apply that to the instrument, and see what parts it cuts: which suppose 24 inches, 2 parts, that is 242 parts: And this is the *diameter at the head*: All which lines appeare in the diagram *A*; where 1.2. is the *line of length*: 3. 4. is the *diameter at the bondge*: and 5. 6. is the *diameter at the end*: All which are instrumentally found out.

It remaineth now that the *meane diameter* be found out which was mentally supposed to reduce the vessell 5. 6. 7. 8. into a *Cylinder*, as *S*, *V*, *W*, *T*, plainely demonstrateth; whose length is equall to the barrell, but the forme is onely different, for the forme of the barrell

is irregular; but the *Cylinder* is regular. So that it appeares all vessells are reduced into regular Cylinders before their content is attained: and how they are reduced, followeth.

To reduce a vessell into a Cylinder, is to find a meane diameter, betweene the diameter at the boudge, and the diameter at the end. Some goe Geometrically to worke, but that proportion is erronious as before. Some goe Arithmetically to worke, and adde both the diameters together, the halfe wherof say they is the meane diameter, but I beleeue them not, for I am sure that is worse then the first. Some doe multiply the diameter at the boudge, by the diameter at the head, and then extract the square roote of that number, and this is all one to the first. For my part I prefeere that way which

I haue found by practise to come neereſt the truth : And that is this.

*Adde the diameter at the boudge, and the diameter at the head together, and the halfe of that ſumme reſerue.*

*Then take the difference of the diameter at the head, and the diameter at the boudge; the fourth part whereof if you adde to that reſerued halfe; that ſumme ſhall be the meane diameter ſought.*

*Example.*

THe diameter at the boudge, 3. 4. was found 306 parts: the diameter at the head 5. 6. was found 242 parts : theſe added, makes 548 parts: the halfe whereof is 274 which reſerue. Then take the difference of the two diameters which is 64 parts: the fourth part whereof

whereof is 16, which added to 274 the halfe reserued, facit 290 parts, for the meane diameter sought, *X Y*. Thus may you find the meane diameter, or *line of measure* in any example whatsoeuer.

And hauing this line of measure, and the line of length in parts, you may find the content in gallons most easily by the logarithmes, & certaine proportionall numbers, which I haue inuented for the same purpose, and applyed vnto the seuerall graduations of an inch, as followeth.

| | | | |
|---|---|---|---|
| | 8 | | 482238 |
| | 10 | parts | 453165 |
| | 12 | taken | 429411 |
| for | 14 | inch, | 409328 |
| | 16 | take | 391931 |
| | 18 | | 376581 |
| | 20 | | 362856 |

If your instrument bee diuided into

into 8 parts in an inch, then take that number right againſt 8 : if into 10 parts in an inch, take the number alſo right againſt 10 &c.

Hitherto hath beene ſhowne how to find the lines, and meane diameter ( or *line of meaſure*). Now let vs find out how many *gallons* this veſſell conteineth.

## *Regula generalis.*

*Firſt ſet downe the log. of the mean diamiter in parts twice.*

*Secondly ſet downe the log. of the line of length in parts.*

*Thirdly ſet downe the Common number belonging to the graduation of the inſtrument.*

*Fourthly adde all theſe 4 logs. together.*

*Fifthly Cut of the figure towards your right hand: for the other figures ſhalbe the log. of the gallon ſought.*

*Example.*

| | | |
|---|---|---|
| meane d. anster | 290 | 246240 |
| meane diamiter | 290 | 246240 |
| line of length | 506 | 270415 |
| for 10 parts in an inch | | 453165 |
| | | 21606c |

If you looke into the table of logs. for this laſt number, you ſhall find the neareſt vnto it, that is leſſe then it to be 215836, and right againſt it the abſolute number 144, for ſo many gallons doth this veſſell conteine: but becauſe the log. produced is greater then this, therfore let vs examine how much.

Firſt take the difference of the logs. of 144 and 145, which wilbe 300, and this is the denominator: then take the difference betweene the log. produced, and that log. which anſwereth to 144, which will be 224, this is the numerator, which

which multiplied by 8 (becauſe there be ſo many pints in a gallon) the product will be 1792, which diuide by the denominator 300, the q iotient will be 6, fere.

I conclude therefore that the log. produced 216060 is the log. of 144 gallons and almoſt 6 pints: And ſo much doth the veſſell conteine.

Another example; when euery inch of the inſtrument is diuided into 8 parts. Suppoſe the diamiter at the boudge, 3.4. to bee 28 inches and 6 parts: then are thoſe 28 inches, 8 times ſo much, that is 224, to which if you adde 6. it will be 230 parts: Then take the diamiter at the head 5.6: which ſuppoſe it be 22 inches, that multiplied by 8, produceth 176 parts. Then take the length of the veſſell 1.2: which ſuppoſe to bee 70 inches and 4 parts, that is 564 parts.

And

And let the content of that veſſell be ſought.

Firſt as you were taught, finde out the meane diameter betweene the diameter at the boudge, and the diameter at the head; which if you worke as you are inſtructed, the meane diamiter will be found to be $216\frac{1}{2}$: and omitting the fraction work as you did before: thus.

| | |
|---|---|
| 216 | 233445 |
| 216 | 233445 |
| 564 | 275128 |
| *for 8 parts in an inch* | 482238 |
| | 1.224256 |

The log. anſwering this queſtion is 224256.

And the neereſt log. vnto it amongſt the tables is 224303, right againſt which is the number 175, and ſo many gallons doth this veſſell hold almoſt. Where note that

it

if the traction of the meane diamiter had not beene omitted, that it would haue beene more then 175 gallons. But if the instrument had beene diuided into 10 parts euery inch, then might the fraction haue beene omitted, and the parts easier reduced: Therefore my counsell is that euery inch of your instrument be diuided in ten parts: If you will haue your instrument diuided into more parts, you haue numbers fit for your purpose.

Thus haue I shewne how the caske are to be gaged, which are equall at both ends.

And if the vessell be not alike at both ends, then take the diameter at each end, & take $\frac{2}{3}$ that summe; which halfe reserue: then take the diameter at the boudge; and betweene that diamiter, and this reserued summe, seeke the meane diamiter as is taught, and so proceed

as

as before, for the finding out of the content. And thus I conclude *Stereometria.*

NOw because I honor the profession of a souldiour, I will show him some vse of these logs. And first of all how to extract a square roote.

*Rule.*

DIvide the log. of the number giuen by 2: Or take halfe the log. of the number giuen (which is all or .) and that halfe shalbe the log. of the roote sought. *Example.* What is the root of 961: Or what is the roote of 900, &c.

| | |
|---|---|
| 961—298272 | 900—295424 |
| 31—149136 | 30—147712 |

The roote of 961 is 31. The root of 900 is 30.

The

The vſe hereof in military Affaires is this.

Suppoſe *A B C D* a ſquare battell conſiſting of 961 men: Or ſuppoſe *A B C D* a ſquare battell conſiſting of 900 men: and the queſtion is to find how many men are in a *Ranke*, as *A B*, or *C D*; and how many in a *File*, as *B C*, or *A D*: here the anſwer of the firſt queſtion is 31 men: and the anſwer of the ſecond queſtion is 30 men. And ſo many are in euery *ranke* and in euery *file*.

If the queſtion bee contrary as thus. There is a ſquare battaile, whoſe *front* is 31 *A B*, and *file* 31 as *B C*: Or there is a ſquare battaile whoſe *front* is 30 men and *file* 30 men. And you deſire to know of how many men theſe battailes conſiſteth.

If you double the log. of 31, that number will bee the log. of 961.

And

And if you double the log. of 30, that number ſhall be the log. of 900. And thus may you worke for all ſquare battells.

But if the forme of the battell be oblong as *E F G H*, and the queſtions be as followeth.

1 If *EFGH* conſiſt of 1000 men, and *E F* the *front* be 10 men; And the queſtion be: how many men be in *F G* the *file*?

2 If the battell *EFGH* conſiſt of 990 men; and the *file F G* be 90: And the demand be how many be in the *front E F*.

For the firſt queſtion worke thus. From the log. of 1000 take the log. of 10, and the remainder ſhall bee the log. of the file demanded.

For the ſecond queſtion worke thus. From the log. of 990 ſubſtract the log. of the file 90, & the remainder ſhall be the log. of the ranke demanded. *Examples.*

1000

| | | | |
|---|---|---|---|
| 1000 | 300000 | 990 | 299563 |
| 10 | 100000 | 90 | 19542 |
| 100 | 200000 | 11 | 104139 |

The file answering to the first question is 100: The Ranke answering to the second question is 11.

But if the ranke and file be giuen and the demand bee, how many men be in that battaile.

Then adde the log. of the *file* to the log. of the *ranke*, & that summe shall be the log. of the battell demanded; *vt supra.*

And thus you see that these two figures are of exigent vse in mathematicall millitary & discipline. He that desireth further instruction herein, if it please him to repaire vnto the author, shall receiue speedy satisfaction. Of whom also you may haue the instruments for *Rabdologie* ready made.

Thus

Thus haue I giuen a generall vſe of the logarithmes, and applied them to profitable occaſions, hoping that they will be well accepted, ſeeing that there is nothing herein intended, but the generall good of all ſuch as are affected with vertuous delight: for whoſe ſakes onely I tooke this paines, to make them familiar and obuious. And if any thing doth content thee, my deſire is, that thou wilt aſcribe the thanks vnto God only, who is the giuer of all good gifts. *Cui ſoli in omnibus omnis debetur honor et gloria. Amen.*

Here followeth the firſt *Chiliade* of *Logarithmes.*

| N | Logarit | N | Logarith | N | Logarith |
|---|---|---|---|---|---|
| 1 | 000000 | 31 | 149136 | 61 | 178532 |
| 2 | 030103 | 32 | 150515 | 62 | 179239 |
| 3 | 047712 | 33 | 151851 | 63 | 179934 |
| 4 | 060206 | 34 | 153147 | 64 | 180618 |
| 5 | 069897 | 35 | 154406 | 65 | 181291 |
| 6 | 077815 | 36 | 155630 | 66 | 181954 |
| 7 | 084509 | 37 | 156820 | 67 | 182607 |
| 8 | 090308 | 38 | 157978 | 68 | 183250 |
| 9 | 095424 | 39 | 159106 | 69 | 183885 |
| 10 | 100000 | 40 | 160205 | 70 | 184509 |
| 11 | 104139 | 41 | 161278 | 71 | 185125 |
| 12 | 107918 | 42 | 162325 | 72 | 185733 |
| 13 | 111394 | 43 | 163346 | 73 | 186332 |
| 14 | 114612 | 44 | 164345 | 74 | 186923 |
| 15 | 117609 | 45 | 165321 | 75 | 187506 |
| 16 | 120411 | 46 | 166275 | 76 | 188081 |
| 17 | 123044 | 47 | 167209 | 77 | 188649 |
| 18 | 125527 | 48 | 168124 | 78 | 189209 |
| 19 | 127875 | 49 | 169019 | 79 | 189762 |
| 20 | 130102 | 50 | 169897 | 80 | 190309 |
| 21 | 132221 | 51 | 170757 | 81 | 190848 |
| 22 | 134242 | 52 | 171600 | 82 | 191381 |
| 23 | 136172 | 53 | 172427 | 83 | 191907 |
| 24 | 138021 | 54 | 173239 | 84 | 192428 |
| 25 | 139794 | 55 | 174036 | 85 | 192941 |
| 26 | 141497 | 56 | 174818 | 86 | 193449 |
| 27 | 143136 | 57 | 175587 | 87 | 193952 |
| 28 | 144715 | 58 | 176342 | 88 | 193448 |
| 29 | 146239 | 59 | 177085 | 89 | 194939 |
| 30 | 147712 | 60 | 177815 | 90 | 195924 |

| Nu. | Logaris. | Nu. | Logarith | Nu | Logarith |
|---|---|---|---|---|---|
| 91 | 195904 | 121 | 208278 | 151 | 217897 |
| 92 | 196378 | 122 | 208636 | 152 | 218184 |
| 93 | 196848 | 123 | 208990 | 153 | 218469 |
| 94 | 197312 | 124 | 209342 | 154 | 218752 |
| 95 | 197772 | 125 | 209691 | 155 | 219033 |
| 96 | 198227 | 126 | 210037 | 156 | 219312 |
| 97 | 198677 | 127 | 210380 | 157 | 219589 |
| 98 | 199122 | 128 | 210720 | 158 | 219865 |
| 99 | 199563 | 129 | 211059 | 159 | 220139 |
| 100 | 200000 | 130 | 211394 | 160 | 220412 |
| 101 | 200432 | 131 | 211727 | 161 | 220682 |
| 102 | 200860 | 132 | 212057 | 162 | 220951 |
| 103 | 201283 | 133 | 212385 | 263 | 221218 |
| 104 | 201703 | 134 | 212710 | 164 | 221484 |
| 105 | 202118 | 135 | 213033 | 165 | 221746 |
| 106 | 202530 | 136 | 213353 | 166 | 222010 |
| 107 | 202938 | 137 | 213672 | 167 | 222272 |
| 108 | 203342 | 138 | 213988 | 168 | 222531 |
| 109 | 203742 | 139 | 214301 | 169 | 222788 |
| 110 | 204139 | 140 | 214612 | 170 | 223044 |
| 111 | 204532 | 141 | 214922 | 171 | 223299 |
| 112 | 204921 | 142 | 215228 | 172 | 223552 |
| 113 | 205307 | 143 | 215533 | 173 | 223804 |
| 114 | 205690 | 144 | 215836 | 174 | 224055 |
| 115 | 206069 | 145 | 216136 | 175 | 224303 |
| 116 | 206445 | 146 | 216435 | 176 | 224551 |
| 117 | 206818 | 147 | 216731 | 177 | 224797 |
| 118 | 207188 | 148 | 217026 | 178 | 225042 |
| 119 | 207554 | 149 | 217318 | 179 | 225285 |
| 120 | 207918 | 150 | 217609 | 180 | 225527 |

| Nu. | Logarith | Nu. | Logarith | Nu. | Logarith |
|---|---|---|---|---|---|
| 181 | 225767 | 211 | 232428 | 241 | 238201 |
| 182 | 226007 | 212 | 232632 | 242 | 238381 |
| 183 | 226245 | 213 | 232837 | 243 | 238560 |
| 184 | 226481 | 214 | 233041 | 244 | 238738 |
| 185 | 226717 | 215 | 233243 | 245 | 238916 |
| 186 | 226951 | 216 | 233445 | 246 | 239093 |
| 187 | 227184 | 217 | 233645 | 247 | 239269 |
| 188 | 227415 | 218 | 233845 | 248 | 239445 |
| 189 | 227646 | 219 | 234044 | 249 | 239619 |
| 190 | 227875 | 220 | 234242 | 250 | 239794 |
| 191 | 228102 | 221 | 234439 | 251 | 239967 |
| 192 | 228330 | 222 | 234635 | 252 | 240140 |
| 193 | 228555 | 223 | 234830 | 253 | 240312 |
| 194 | 228780 | 224 | 235024 | 254 | 240483 |
| 195 | 229003 | 225 | 235218 | 255 | 240654 |
| 196 | 229225 | 226 | 235410 | 256 | 240823 |
| 197 | 229446 | 227 | 235602 | 257 | 240993 |
| 198 | 229666 | 228 | 235793 | 258 | 241161 |
| 199 | 229885 | 229 | 235983 | 259 | 241329 |
| 200 | 230102 | 230 | 236172 | 260 | 241497 |
| 201 | 230319 | 231 | 236361 | 261 | 241664 |
| 202 | 230535 | 232 | 236548 | 262 | 241830 |
| 203 | 230749 | 233 | 236735 | 263 | 241995 |
| 204 | 230963 | 234 | 236921 | 264 | 242160 |
| 205 | 231175 | 235 | 237106 | 265 | 242324 |
| 206 | 231386 | 236 | 237291 | 266 | 242488 |
| 207 | 231597 | 237 | 237474 | 267 | 242651 |
| 208 | 231806 | 238 | 237657 | 268 | 242813 |
| 209 | 232014 | 239 | 237839 | 269 | 242975 |
| 210 | 232221 | 240 | 238021 | 270 | 243136 |

| Nu. | Logarith | Nu | Logarith | Nu. | Logarith |
|---|---|---|---|---|---|
| 271 | 243297 | 301 | 247856 | 331 | 251982 |
| 272 | 243456 | 302 | 248000 | 332 | 252113 |
| 273 | 243616 | 303 | 248144 | 333 | 252244 |
| 274 | 243775 | 304 | 248287 | 334 | 252374 |
| 275 | 243933 | 305 | 248429 | 335 | 252504 |
| 276 | 244090 | 306 | 248572 | 336 | 252637 |
| 277 | 244248 | 307 | 248713 | 337 | 252764 |
| 278 | 244404 | 308 | 248855 | 338 | 252891 |
| 279 | 244560 | 309 | 248995 | 339 | 253019 |
| 280 | 244715 | 310 | 249136 | 340 | 253147 |
| 281 | 244870 | 311 | 249276 | 341 | 253275 |
| 282 | 245025 | 312 | 249415 | 342 | 253422 |
| 283 | 245178 | 313 | 249554 | 343 | 253539 |
| 284 | 245331 | 314 | 249693 | 344 | 253655 |
| 285 | 245484 | 315 | 249831 | 345 | 253782 |
| 286 | 245636 | 316 | 249968 | 346 | 253907 |
| 287 | 245788 | 317 | 250105 | 347 | 254033 |
| 288 | 245939 | 318 | 250242 | 348 | 254157 |
| 289 | 246089 | 319 | 250379 | 349 | 254282 |
| 290 | 246239 | 320 | 250515 | 350 | 254406 |
| 291 | 246389 | 321 | 250650 | 351 | 254530 |
| 292 | 246538 | 322 | 250785 | 352 | 254654 |
| 293 | 246686 | 323 | 250920 | 353 | 254777 |
| 294 | 246834 | 324 | 251054 | 354 | 254900 |
| 295 | 246982 | 325 | 251188 | 355 | 255022 |
| 296 | 247129 | 326 | 251421 | 356 | 255145 |
| 297 | 247275 | 327 | 251354 | 357 | 255266 |
| 298 | 247421 | 328 | 251587 | 358 | 255388 |
| 299 | 247567 | 329 | 251719 | 359 | 255509 |
| 300 | 247712 | 330 | 251851 | 360 | 255630 |

| Nu. | Logarith | Nu. | Logarith | Nu. | Logarith |
|---|---|---|---|---|---|
| 361 | 255750 | 391 | 259217 | 421 | 262428 |
| 362 | 255870 | 392 | 259328 | 422 | 262531 |
| 363 | 255990 | 393 | 259439 | 423 | 262634 |
| 364 | 256110 | 394 | 259549 | 424 | 262736 |
| 365 | 256229 | 395 | 259659 | 425 | 262838 |
| 366 | 256348 | 396 | 259769 | 426 | 262941 |
| 367 | 256466 | 397 | 259879 | 427 | 263042 |
| 368 | 256584 | 398 | 259988 | 428 | 263144 |
| 369 | 256702 | 399 | 260097 | 429 | 263245 |
| 370 | 256820 | 400 | 260206 | 430 | 263346 |
| 371 | 256937 | 401 | 260314 | 431 | 263447 |
| 372 | 257054 | 402 | 260422 | 432 | 263548 |
| 373 | 257170 | 403 | 260530 | 433 | 263648 |
| 374 | 257287 | 404 | 260638 | 434 | 263749 |
| 375 | 257403 | 405 | 260745 | 435 | 263849 |
| 376 | 257518 | 406 | 260852 | 436 | 263949 |
| 377 | 257634 | 407 | 260959 | 438 | 264148 |
| 378 | 257749 | 408 | 261066 | 438 | 264147 |
| 379 | 257864 | 409 | 261172 | 439 | 264246 |
| 380 | 257878 | 410 | 261278 | 440 | 264345 |
| 381 | 258092 | 411 | 261384 | 441 | 264443 |
| 382 | 258206 | 412 | 261489 | 442 | 264542 |
| 383 | 258319 | 413 | 261595 | 443 | 64640 |
| 384 | 258433 | 414 | 261700 | 444 | 264737 |
| 385 | 258546 | 415 | 261804 | 445 | 264836 |
| 386 | 258658 | 416 | 261909 | 446 | 264933 |
| 387 | 258771 | 417 | 262013 | 447 | 265030 |
| 388 | 258883 | 418 | 262117 | 448 | 265127 |
| 389 | 258995 | 419 | 262221 | 449 | 265224 |
| 390 | 259106 | 420 | 262324 | 450 | 265321 |

| Nu. | Logarith | Nu | Logarith | N. | Logarith |
|---|---|---|---|---|---|
| 451 | 265417 | 481 | 268214 | 511 | 270842 |
| 452 | 265513 | 482 | 268304 | 512 | 270927 |
| 453 | 265609 | 483 | 268394 | 513 | 271011 |
| 454 | 265705 | 484 | 268484 | 514 | 271069 |
| 455 | 265801 | 485 | 268574 | 515 | 271180 |
| 456 | 265896 | 486 | 268663 | 516 | 271264 |
| 457 | 265991 | 487 | 298752 | 517 | 271349 |
| 458 | 266086 | 488 | 266841 | 518 | 271432 |
| 459 | 266681 | 489 | 268930 | 519 | 271516 |
| 460 | 266275 | 490 | 269019 | 520 | 271600 |
| 461 | 266370 | 491 | 269108 | 521 | 271683 |
| 462 | 266464 | 492 | 269196 | 522 | 271767 |
| 463 | 266558 | 493 | 269284 | 523 | 271850 |
| 464 | 266651 | 494 | 269372 | 524 | 271933 |
| 465 | 266745 | 495 | 269460 | 525 | 272015 |
| 466 | 266838 | 496 | 269548 | 526 | 272098 |
| 467 | 266931 | 497 | 269635 | 527 | 272181 |
| 468 | 267024 | 498 | 269722 | 528 | 272263 |
| 469 | 267117 | 499 | 269810 | 529 | 272345 |
| 470 | 267209 | 500 | 269897 | 530 | 272427 |
| 471 | 267302 | 501 | 268983 | 531 | 272509 |
| 472 | 267394 | 502 | 270070 | 532 | 272591 |
| 473 | 267486 | 503 | 270156 | 533 | 272672 |
| 474 | 267577 | 504 | 270243 | 534 | 272754 |
| 475 | 267669 | 505 | 270329 | 535 | 272835 |
| 476 | 67760 | 506 | 270415 | 536 | 272916 |
| 477 | 267851 | 507 | 270500 | 537 | 272997 |
| 478 | 267942 | 508 | 270586 | 538 | 273078 |
| 479 | 268033 | 509 | 270671 | 539 | 273158 |
| 480 | 68124 | 510 | 470757 | 540 | 273239 |

| Nu | Logarith | Nu. | Logarith | Nu. | Logarith |
|---|---|---|---|---|---|
| 541 | 273319 | 571 | 275663 | 601 | 277887 |
| 542 | 273399 | 572 | 275739 | 602 | 277959 |
| 543 | 273479 | 573 | 275815 | 603 | 278031 |
| 544 | 273559 | 574 | 275891 | 604 | 278103 |
| 545 | 273639 | 575 | 275966 | 605 | 278175 |
| 546 | 273719 | 576 | 276042 | 606 | 278247 |
| 547 | 273798 | 577 | 276117 | 607 | 278318 |
| 548 | 273878 | 578 | 276192 | 608 | 278390 |
| 549 | 273957 | 579 | 276267 | 609 | 278461 |
| 550 | 274036 | 580 | 276342 | 610 | 278532 |
| 551 | 274115 | 581 | 276417 | 611 | 278604 |
| 552 | 274193 | 582 | 276492 | 612 | 278675 |
| 553 | 27 .272 | 583 | 276566 | 613 | 278746 |
| 554 | 274350 | 584 | 276641 | 614 | 278816 |
| 555 | 274429 | 585 | 76715 | 615 | 278887 |
| 556 | 274507 | 586 | 276789 | 616 | 278958 |
| 557 | 274585 | 587 | 276863 | 617 | 279028 |
| 558 | 274663 | 588 | 276937 | 618 | 279098 |
| 550 | 274741 | 589 | 277011 | 619 | 279169 |
| 560 | 274818 | 590 | 277085 | 620 | 279239 |
| 561 | 274896 | 591 | 277158 | 621 | 279309 |
| 562 | 274973 | 592 | 277232 | 622 | 279379 |
| 563 | 275050 | 593 | 277305 | 623 | 279448 |
| 564 | 275128 | 594 | 277378 | 624 | 279518 |
| 565 | 275204 | 595 | 277451 | 625 | 279588 |
| 566 | 275281 | 596 | 277524 | 626 | 279657 |
| 567 | 275358 | 597 | 277597 | 627 | 279726 |
| 568 | 275434 | 598 | 277670 | 628 | 279795 |
| 569 | 275511 | 599 | 277742 | 629 | 279865 |
| 570 | 275587 | 600 | 277815 | 630 | 279934 |

| Nu. | Logarithi | Nu. | Logarithi | Nu. | Logarithi |
|---|---|---|---|---|---|
| 631 | 280003 | 681 | 282020 | 691 | 283947 |
| 632 | 280071 | 682 | 282085 | 692 | 284010 |
| 633 | 280140 | 683 | 282151 | 693 | 284073 |
| 634 | 280209 | 684 | 282216 | 694 | 284136 |
| 635 | 280277 | 685 | 282282 | 695 | 284198 |
| 636 | 280345 | 686 | 282347 | 696 | 284261 |
| 637 | 280414 | 687 | 282412 | 697 | 284323 |
| 638 | 280482 | 688 | 282477 | 698 | 284385 |
| 639 | 280550 | 689 | 282542 | 699 | 284447 |
| 640 | 280618 | 690 | 282607 | 700 | 284509 |
| 641 | 280685 | 691 | 282672 | 701 | 284571 |
| 642 | 280753 | 692 | 282737 | 702 | 284633 |
| 643 | 280821 | 693 | 282801 | 703 | 284695 |
| 644 | 280888 | 694 | 282866 | 704 | 284757 |
| 645 | 280956 | 695 | 282930 | 705 | 284819 |
| 646 | 281023 | 696 | 282994 | 706 | 284880 |
| 647 | 281090 | 697 | 283058 | 707 | 284942 |
| 648 | 281157 | 698 | 283123 | 708 | 285003 |
| 649 | 281224 | 699 | 283187 | 709 | 285064 |
| 650 | 281291 | 680 | 283250 | 710 | 285125 |
| 651 | 281358 | 681 | 283314 | 711 | 285187 |
| 652 | 281424 | 682 | 283378 | 712 | 285248 |
| 653 | 281491 | 683 | 283442 | 713 | 285309 |
| 654 | 281557 | 684 | 283505 | 714 | 285369 |
| 655 | 281624 | 685 | 283569 | 715 | 285430 |
| 656 | 281690 | 686 | 283632 | 716 | 285491 |
| 657 | 281756 | 687 | 283695 | 717 | 285551 |
| 658 | 281822 | 688 | 283758 | 718 | 285612 |
| 659 | 281888 | 689 | 283821 | 719 | 285672 |
| 660 | 281954 | 690 | 283884 | 720 | 285733 |

| Nu. | Logarith |
|---|---|
| 721 | 285793 |
| 722 | 285853 |
| 723 | 285913 |
| 724 | 285973 |
| 725 | 286033 |
| 726 | 286093 |
| 727 | 286153 |
| 728 | 286213 |
| 729 | 286272 |
| 730 | 286332 |
| 731 | 286391 |
| 732 | 286451 |
| 733 | 286510 |
| 734 | 286569 |
| 735 | 286628 |
| 736 | 286687 |
| 737 | 286746 |
| 738 | 286805 |
| 739 | 286864 |
| 740 | 286923 |
| 741 | 286981 |
| 742 | 287040 |
| 743 | 287098 |
| 744 | 287157 |
| 745 | 287215 |
| 746 | 287273 |
| 747 | 287331 |
| 748 | 287390 |
| 749 | 287448 |
| 750 | 287506 |

| Nu. | Logarith |
|---|---|
| 751 | 287564 |
| 752 | 287621 |
| 753 | 287679 |
| 754 | 287737 |
| 755 | 287947 |
| 756 | 287852 |
| 757 | 287909 |
| 758 | 287967 |
| 759 | 288024 |
| 760 | 288081 |
| 761 | 288138 |
| 762 | 288195 |
| 763 | 288252 |
| 764 | 288309 |
| 765 | 288366 |
| 766 | 288422 |
| 767 | 288479 |
| 768 | 288536 |
| 769 | 288594 |
| 770 | 288649 |
| 771 | 288705 |
| 772 | 288761 |
| 773 | 288818 |
| 774 | 288874 |
| 775 | 288930 |
| 776 | 288986 |
| 777 | 289042 |
| 778 | 289098 |
| 779 | 289153 |
| 780 | 289209 |

| Nu. | Logarith |
|---|---|
| 781 | 289265 |
| 782 | 288320 |
| 783 | 289376 |
| 784 | 289431 |
| 785 | 289486 |
| 786 | 289542 |
| 787 | 289597 |
| 788 | 289652 |
| 789 | 289707 |
| 790 | 289762 |
| 791 | 289817 |
| 792 | 289872 |
| 793 | 289927 |
| 794 | 289982 |
| 795 | 290036 |
| 796 | 290091 |
| 797 | 290145 |
| 798 | 290200 |
| 799 | 290254 |
| 800 | 290309 |
| 801 | 290363 |
| 802 | 290417 |
| 803 | 290471 |
| 804 | 290525 |
| 805 | 290579 |
| 806 | 290633 |
| 807 | 290687 |
| 808 | 290741 |
| 809 | 290795 |
| 810 | 290848 |

| Nu. | Logarith | Nu | Logarith | Nu. | Logarith |
|---|---|---|---|---|---|
| 811 | 290902 | 841 | 292479 | 871 | 294001 |
| 812 | 290955 | 842 | 292531 | 872 | 294051 |
| 813 | 291009 | 843 | 292582 | 873 | 294101 |
| 814 | 291062 | 844 | 292634 | 874 | 294151 |
| 815 | 291115 | 845 | 292685 | 875 | 294200 |
| 816 | 291169 | 846 | 292737 | 876 | 294250 |
| 817 | 291222 | 847 | 292788 | 877 | 294299 |
| 818 | 291275 | 848 | 292839 | 878 | 294349 |
| 819 | 291328 | 849 | 292890 | 879 | 294398 |
| 820 | 291381 | 850 | 292941 | 880 | 294448 |
| 821 | 291434 | 851 | 292992 | 881 | 294497 |
| 822 | 291487 | 852 | 293044 | 882 | 294546 |
| 823 | 291539 | 853 | 293095 | 883 | 294596 |
| 824 | 291592 | 854 | 293145 | 884 | 294645 |
| 825 | 291645 | 855 | 293196 | 885 | 294694 |
| 826 | 291698 | 856 | 293247 | 886 | 294743 |
| 827 | 291750 | 857 | 293298 | 887 | 294791 |
| 828 | 291803 | 858 | 293348 | 888 | 294841 |
| 829 | 291855 | 859 | 293399 | 889 | 294890 |
| 830 | 291907 | 860 | 293499 | 890 | 294939 |
| 831 | 291960 | 861 | 293500 | 891 | 294987 |
| 832 | 292012 | 862 | 293550 | 892 | 295036 |
| 833 | 292064 | 863 | 293601 | 893 | 295085 |
| 834 | 292116 | 864 | 293651 | 894 | 295133 |
| 835 | 292168 | 865 | 293701 | 895 | 295182 |
| 836 | 292220 | 866 | 293751 | 896 | 295230 |
| 837 | 292272 | 867 | 293802 | 897 | 295279 |
| 838 | 292324 | 868 | 293852 | 898 | 295327 |
| 839 | 292376 | 869 | 293902 | 899 | 295375 |
| 840 | 292428 | 870 | 293952 | 900 | 295424 |

| Nu. | Logarith. | Nu. | Logarith. | Nu. | Logarith. |
|---|---|---|---|---|---|
| 901 | 295520 | 931 | 296895 | 961 | 298272 |
| 902 | 295520 | 932 | 296941 | 962 | 298317 |
| 903 | 295568 | 933 | 296988 | 963 | 298362 |
| 904 | 295616 | 934 | 297034 | 964 | 298407 |
| 905 | 295664 | 935 | 297081 | 965 | 298452 |
| 906 | 295712 | 936 | 297127 | 966 | 298497 |
| 907 | 295760 | 937 | 297174 | 967 | 298542 |
| 908 | 295808 | 938 | 297220 | 968 | 298587 |
| 909 | 295856 | 939 | 297268 | 969 | 298632 |
| 910 | 295904 | 940 | 297312 | 970 | 198677 |
| 911 | 295951 | 941 | 297359 | 971 | 298722 |
| 912 | 295999 | 942 | 297405 | 972 | 298766 |
| 913 | 296047 | 943 | 297451 | 973 | 298811 |
| 914 | 296094 | 944 | 297497 | 974 | 298855 |
| 915 | 296142 | 945 | 297543 | 975 | 298900 |
| 916 | 296189 | 946 | 297589 | 976 | 298945 |
| 917 | 296237 | 947 | 297635 | 977 | 298989 |
| 918 | 296284 | 948 | 297680 | 978 | 299033 |
| 919 | 296331 | 949 | 297726 | 979 | 299078 |
| 920 | 296378 | 950 | 297772 | 980 | 299122 |
| 921 | 296426 | 951 | 297818 | 98 | 299167 |
| 922 | 296473 | 952 | 297863 | 982 | 299211 |
| 923 | 296520 | 953 | 297909 | 983 | 299255 |
| 924 | 296567 | 954 | 297954 | 984 | 299299 |
| 925 | 296614 | 955 | 298000 | 985 | 299343 |
| 926 | 296661 | 956 | 298045 | 986 | 299387 |
| 927 | 296708 | 957 | 298091 | 987 | 299431 |
| 928 | 296754 | 958 | 298613 | 988 | 299475 |
| 929 | 296801 | 959 | 298181 | 989 | 299519 |
| 930 | 296848 | 960 | 298227 | 990 | 299563 |

| Num. | Logarith | Num. | Logarith | Num | Logarith |
|---|---|---|---|---|---|
| 991 | 299607 | 995 | 299782 | 999 | 299956 |
| 992 | 299651 | 996 | 299826 | 1000 | 300000 |
| 993 | 299695 | 997 | 299869 | | |
| 994 | 299738 | 998 | 299913 | | |

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